The chamber 10 is or may be fitted with a valve 26 (Figure 10) or a perforated cap, to allow for any variation of pressure in the chamber either above or below the pressure of the atmosphere.

Suitable means are provided when it is desired to be able to vary the stroke of the stamp-head. Figure 6 is a vertical section showing one arrangement for this purpose, in which additional ports 9*a* are made in the side of the cylinder 4 at levels corresponding to the length of the stroke required. The ports 9, 9*a* in such a case are each provided with a valve 27, capable of being readily controlled by a handle 28, so that ports not required for the time being can be readily closed, and that which it is desired to use can be readily opened.

Figure 7 is a vertical section showing another arrangement for this purpose, in which the cylinder 4 has formed in its inner surface a longitudinal groove 4^a, in which is an adjustable slide-bar 29, formed with a rack in gear with a pinion 30, by suitably moving which from the exterior of the cylinder the closing of the communication between the two ends of the cylinder by way of the said groove 4^a can be caused to take place at any desired part of the stroke of the piston 5 relatively to the cylinder 4.

It will be evident that (if so desired) the piston may be connected to the crank so as to be actuated thereby, in which case the stamp-stem will be attached to the cylinder, or (as represented in Figure 8) the cylinder, actuated by the crank, instead of having a hole through the bottom, may have the stuffing-box at its top, a cross-head 6^a being attached to the upper end of the piston-rod, and connected to an upwardly-extending bifurcated portion 6^3 of the stamp-stem 6. The cylinder may be prolonged below the cut-off port to such an extent that in the event of escape through leakage of the whole of the liquid from below the port the piston will not strike against the cylinder-bottom, or below the port there may be a spring adapted to act when necessary in lieu of liquid during the return or upward stroke of the positively-driven parts and stamp.

In Figure 9 there is shown a spiral spring with an annular plate above it; but there might obviously be substituted some other form of spring, such as an indiarubber buffer-spring.

If it is desired that the revolutions of the driving-shaft 2 shall be less in number than heretofore mentioned, and that the apparatus shall still embody the requirements of a gravity stamp, then, at the lower end of the cylinder 4 (Figures 10 and 11) there is placed a valve that is capable of being actuated by any suitable means (it may be an eccentric, tappets, cams, or other equivalent devices), in such a manner that communication between the interior of the cylinder and the reservoir is opened and closed as required. Figure 10 is a vertical section, and Figure 11 a side elevation, showing an arrangement of this kind, wherein 31 is a valve controlling a port 9^* arranged at the bottom of the cylinder 4 for placing the same in communication with the chamber 10. In this case the arrangement, as will be seen, is such that the piston 5 and stamp-head will be lifted through the medium of liquid 12 imprisoned below the piston, as in the arrangement shown in Figures 1 to 8, and they are allowed to fall under the action of gravity, and independent of the movement of the cylinder 4, by opening the valve 31 so as to establish free communication between the cylinder 4 and the reservoir 10. The cylinder is prolonged upwards so as to prevent its upper end coming in contact, on the down-stroke, with the piston in the event of the stamp-head being prevented from making its full down-stroke; and at that point of the upper portion of the cylinder at which the piston will be located when a full stroke of the cylinder has been made there is an opening 11^a between the cylinder and reservoir through which liquid can pass in order that the stamp-head will not be raised until the relative normal position of piston and cylinder is reached, so that the stamp-head will never be raised beyond a predetermined height, no matter what proportion of the full stroke it may have dropped. Or, in lieu of the port 11^a, there may be a port 5^a in the piston 5 which is opened and closed by a rod (see Figure 12), thus dispensing with the independent chamber. The controlling-valve 31 may be of any suitable type, such as a rotary valve having a slotted periphery as shown, and be operated at the required times through an arm 31^a on its stem by moving tappets 32, 32^a on a rod 33 worked from an eccentric on the driving-shaft or by fixed tappets.

In each arrangement any one of the rods 6 with stamp-head 8 can, when desired, be held up or out of action without interfering with the working of the remainder of the series.

Obviously this invention will enable stamps to be operated more rapidly than has been found practicable where gravity alone has been relied upon for effecting the downward strokes, because, as is well known, in stamp-batteries of the kind in which the stamp-heads are allowed to fall through a distance of about 7 in. by gravity, and are raised by cams or wipers, it has hitherto been impracticable to obtain more than from 100 to 105 blows per minute, and of the power expended a large proportion has been wasted in friction; whereas my invention renders it practicable to neutralise the retarding effect due to friction, and, when necessary, to supplement the force due to gravity, thereby rendering it possible to obtain a greater number of blows per minute and a greater crushing-capacity per stamp-head, whilst, by obviating to a large extent sudden shocks, the apparatus is also rendered less liable to break down than apparatus of the ordinary construction, and of the power expended a larger proportion may be usefully employed than heretofore has been usual.

As will be obvious, the essential feature of this apparatus renders it suitable not only for the purposes indicated, but also for operating dies, for sharpening rock-drills and the like, and for various other hammering purposes.

I reserve the right to modify details of construction to suit different requirements.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is,—

1. A stamping apparatus (for crushing minerals, gold-ores, and other crushing, stamping, or hammering purposes) characterized by the peculiarity that the downward or operative strokes of the stamps are effected by the combined action of gravity and motion imparted by friction from